

LEVEL

7W

12

AFGL-TR-81-0103
INSTRUMENTATION PAPERS, NO. 301

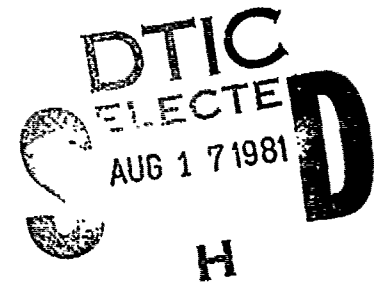


AD A102907

PCM Snap Shot System for Multi-Spectral Measurements Program

WILLIAM B. MILLER
RANDALL BURNS, Capt, USAF
STEPHEN O. DAVIS

30 March 1981



Approved for public release; distribution unlimited.

AEROSPACE INSTRUMENTATION DIVISION PROJECT 2123
AIR FORCE GEOPHYSICS LABORATORY
HANSCOM AFB, MASSACHUSETTS 01731

AIR FORCE SYSTEMS COMMAND, USAF



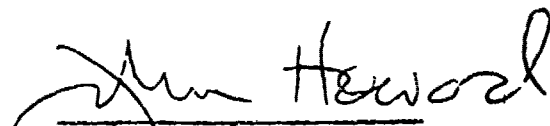
81 8 17 059

DTIC FILE COPY

This report has been reviewed by the ESD Information Office (OI) and is releasable to the National Technical Information Service (NTIS).

This technical report has been reviewed and is approved for publication.

FOR THE COMMANDER



Chief Scientist

Qualified requestors may obtain additional copies from the Defense Technical Information Center. All others should apply to the National Technical Information Service.

(14) AFG-L-TR-81-0103
AFGL-IP-24

Unclassified

SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

REPORT DOCUMENTATION PAGE		READ INSTRUCTIONS BEFORE COMPLETING FORM	
1. REPORT NUMBER AFGL-TR-81-0103 ✓	2. GOVT ACCESSION NO. AD A302907	3. RECIPIENT'S CATALOG NUMBER	
4. TITLE (and Subtitle) PCM SNAP SHOT SYSTEM FOR MULTI-SPECTRAL MEASUREMENTS PROGRAM		5. TYPE OF REPORT & PERIOD COVERED Final Report	
6. AUTHOR(s) William B. Miller Randall Burns Capt USAF Stephen O. Davis*		7. PERFORMING ORG. REPORT NUMBER IP No. 301 ✓	8. CONTRACT OR GRANT NUMBER(s)
9. PERFORMING ORGANIZATION NAME AND ADDRESS Air Force Geophysics Laboratory (LCR) Hanscom AFB Massachusetts 01731		10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS 63424F 21230302	
11. CONTROLLING OFFICE NAME AND ADDRESS Air Force Geophysics Laboratory (LCR) Hanscom AFB Massachusetts 01731		12. REPORT DATE 30 March 1981	
14. MONITORING AGENCY NAME & ADDRESS (if different from Controlling Office) (12) 30		13. NUMBER OF PAGES 28	
		15. SECURITY CLASS. (of this report) Unclassified	
15a. DECLASSIFICATION DOWNGRADING SCHEDULE			
16. DISTRIBUTION STATEMENT (of this Report) Approved for public release; distribution unlimited.			
17. DISTRIBUTION STATEMENT (of abstract entered in Block 20, if different from Report)			
18. SUPPLEMENTARY NOTES * Real Time Software Systems, Inc.			
19. KEY WORDS (Continue on reverse side if necessary and identify by block number) Telemetry Real time display Decommuration Digital data display PCM			
20. ABSTRACT (Continue on reverse side if necessary and identify by block number) ✓ This report deals with a software system which is intended to provide fast real-time and on-line analysis of critical go-no go data in the blockhouse during launch operation. It is an answer to the burgeoning data flow created by modern PCM telemetry systems.			

DTIC
ELECTE
17 1981

DD FORM 1 JAN 73 1473

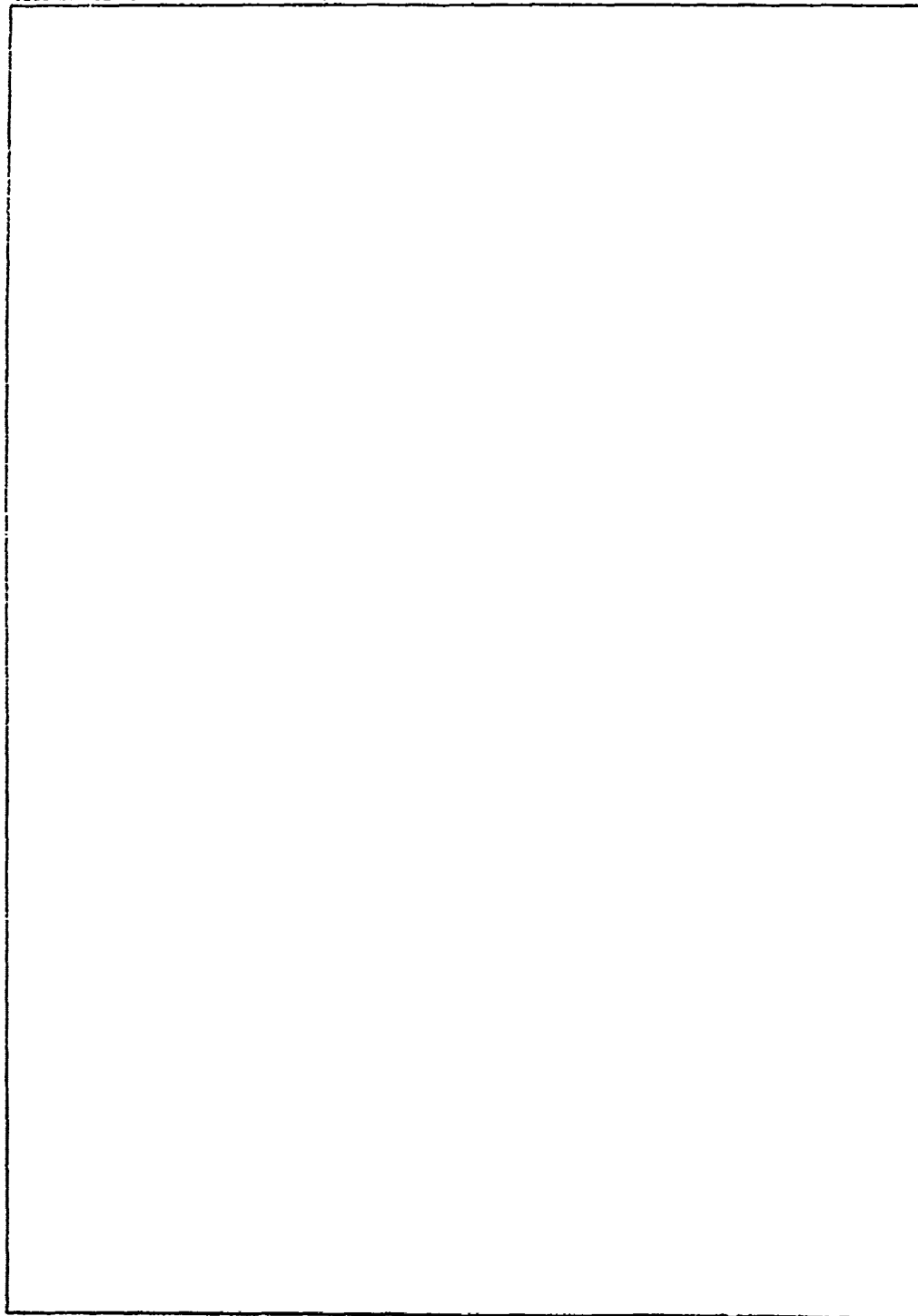
Unclassified

SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

404578

24

SECURITY CLASSIFICATION OF THIS PAGE(When Data Entered)



SECURITY CLASSIFICATION OF THIS PAGE(When Data Entered)

Accession For	
By	<input checked="" type="checkbox"/>
Distribution	<input type="checkbox"/>
Availability Codes	
Dist	Avail and/or Special
A	

Contents

1. INTRODUCTION	5
2. SYSTEM OVERVIEW	6
2.1 Attribute List	6
2.2 Decommuration List	6
2.3 Display List	7
2.4 Print List	7
3. SNAP SHOT SYSTEM OPERATION	7
3.1 SSEDIT Operation	7
3.1.1 Editing the Lists	7
3.1.1.1 Edit Attribute List	8
3.1.1.2 Edit Decommuration List	10
3.1.1.3 Edit Display List and Edit Print List	10
3.1.2 Displaying the Lists	11
3.1.2.1 Display Attribute List	12
3.1.2.2 Display Decommuration List	12
3.1.2.3 Display Print List and Display List	12
3.1.3 Printing the Lists	12
3.2 SSRUN Operation	13
3.2.1 Single Snap Shots	13
3.2.2 Snap Shot Monitor	13
3.2.3 Data Reporting	13
3.2.3.1 Display and Printout Formats	13
3.2.4 Data Handling	14
3.2.4.1 Discrete Data	14
3.2.4.2 Analog Data	14
3.2.4.3 Two's Compliment A/D Data	14
3.2.4.4 Offset Binary A/D Data	14
3.2.4.5 Sign Magnitude A/D data	14
3.2.4.6 Conversion From A/D Counts to Volts	15
3.2.4.7 Analog Data Not Treated as a Level	15
3.2.4.8 Conversion to Engineering Units	15

Contents

3.2.4.9 Processing Analog Data Treated as a Level	15
3.2.4.10 Special Data	15
4. CONCLUSION	15
APPENDIX A: List Specifications and Contents	17
APPENDIX B: SSLIB Subroutine Library	23

Tables

1. SSEDIT Main Menu	8
2. SSRUN Data Reporting Format	14

PCM Snap Shot System for Multi-Spectral Measurements Program

1. INTRODUCTION

The advent of Pulse Code Modulation (PCM) techniques has created a situation in the sounding-rocket community with which it has been reluctant to come to grips. Before PCM opened a new and far reaching horizon in the field of data transmission, scientists in the sounding-rocket community were sorely hampered in the quantity of data available on any given rocket.

This constraint led to small telemetry setups in the blockhouse with only a few oscillograph recorders and perhaps an oscilloscope or two with wiggly traces indicating the health of the experiment and rocket system. These simple setups were able to provide the scientists and engineers in the blockhouse the go/no-go information necessary in the final phases of the countdown.

Now with the increased capability available from PCM the scientist and engineer is faced with a situation where the health of the experiment is determined by the Gaussian distribution of the minute noise signals on each one of the eighty or so detectors in a liquid-helium-cooled instrument.

The Multi-Spectral Measurements Program presents a vast amount of data that must be digested by the personnel in the blockhouse to measure the health of the whole system, experiments, payload engineering, and vehicle. There are over 600 separate data measurements made by the telemetry system. If one considers

(Received for publication 27 March 1981)

the effects of the various filter positions in the Ultraviolet Experiments, this number reaches the staggering sum of over 1500 measurements made at sampling rates from 10 samples per second to 1000 samples per second.

This amount of data streaming into the blockhouse has created the necessity to develop some method of automatically handling the critical items and presenting these in understandable terms to the people who must make the go/no-go decision. This report discusses the Aerospace Instrumentation Division's attempts to deal with this necessity.

2. SYSTEM OVERVIEW

The "Snap Shot" System is a list-driven system which takes into memory a major frame of telemetry data up to 4000 words in length and processes it according to operator specified parameters. Results of limit checks and data conversions performed on selected PCM data are reported with operator defined messages on a display terminal and line printer.

The Snap Shot System is contained within two main programs, SSEDIT to create the appropriate files, and SSRUN to run the system, and a subroutine library, SSLIB. These routines are written for RT-11 Version 3B operating on a PDP-11 system with a VT55 display terminal, LA36 DECwriter II, an EMR710 decommutator and a random access storage device such as the RK05 disk.

The list-driven feature of this system allows the operator to easily modify the software's operation by merely changing a list of attributes rather than by the re-programming for each change in requirements. Lists are set up through keyboard using displayed menus and are saved in disk files for subsequent use. There are four such lists used by the system.

2.1 Attribute List

This list contains information on data type, conversion to engineering units, limit checks, and messages for data reporting. The file name for this list is "DK:SSLA.DAT". It is a Fortran random access type file containing 200 logical records numbered from 0 to 199, with each record 100 words long. The entries in the logical records depend upon the type of variable: discrete, special, analog, or analog treated as a level. The different types of logical records are described in Section 4.

2.2 Decommutation List

This list contains the necessary data for setting up the PCM decommutator format and properly identifying the data in the PCM stream. It is a one record Fortran sequential file. File name for this list is "DK:SSLB.DAT".

2.3 Display List

The display list is an open-ended Fortran sequential file containing information on variables to be displayed on the VT55 screen. Each logical record contains the frame number, word number, and attribute list number of the variable to be reported on the display screen. File name for this list is "DK:SSLC.DAT".

2.4 Print List

The print list has the same format and function as the display list; the only difference being that the information will be output to the system's line printer (the LA36). The file name for this list is "DK:SSLD.DAT".

3. SNAP SHOT SYSTEM OPERATION

3.1 SSEDIT Operation

The Snap Shot editor program is used to initialize, modify, display, and print the four descriptive lists. Through SSEDIT the operator defines data characteristics and sets up reporting procedures for later processing by the SSRUN program. The editor is designed to allow modification of individual list elements while retaining all other information in the list. Editing of a list can be aborted in a manner that preserves all information contained prior to edit of that list. SSEDIT can be loaded and executed by issuing the "RUN" command to the RT-11 monitor. Once SSEDIT starts executing, it performs a directory search on device "DK:" to locate the four descriptive lists—SSLA.DAT, SSLB.DAT, SSLC.DAT, and SSLD.DAT. If any of these files are not found, then a file is created initializing the corresponding lists to all zeroes. Creation of a file in this manner will be reported on the VT55 screen.

The SSEDIT main menu is depicted in Table 1. The menu is displayed after file initialization and at the completion of editing, displaying, or printing one of the four lists. Acceptance of the user's selection from the menu is indicated by erasure of the display screen. Non-acceptance causes the prompt character to be re-displayed on the next line.

3.1.1 EDITING THE LISTS

The attribute, display and print lists are multiple logical record files that cause a second menu to be displayed. The user may select the attribute or item (logical record) number that he wishes to edit or he may choose to exit and return to the main menu. Entry of a logical record number that is outside the file's boundaries will cause another prompt character to be displayed on the next line. In addition to item number, the display and print list edit menus also require input of the action that is to be taken; insert, delete, change, list, save, or unsave.

No menu is generated for edit of the decommutation list, SSLB.DAT, since it is a single record file.

Table 1. SSEDIT Main Menu

1 = EDIT ATTRIBUTE LIST	8 = DISPLAY PRINT LIST
2 = EDIT DECOMMUTATION LIST	15 = PRINT ATTRIBUTE LIST
3 = EDIT DISPLAY LIST	16 = PRINT DECOMMUTATION LIST
4 = EDIT PRINT LIST	17 = PRINT DISPLAY LIST
5 = DISPLAY ATTRIBUTE LIST	18 = PRINT PRINT LIST
6 = DISPLAY DECOMMUTATION LIST	-1 = EXIT
7 = DISPLAY DISPLAY LIST	?

After the user specifies a logical record to edit, SSEDIT erases the display screen, displays a heading, and then steps through the individual list elements for editing. Note that for display and print list edit, the elements are stepped through only when inserting or changing an item. List element descriptions along with current contents are displayed followed by the "?" prompt character on the next line. The user has the option of modifying the contents of the list element by entering a new value or the current value can be retained by entering only a carriage return. User entries are in the form of numerical values in octal, integer and floating point format or ASCII strings in alphanumeric format. Some list elements require only a single character entry. These entries usually pertain to processing options such as limit checks, data inversions and conversions.

SSEDIT validates user entries with interactive error reporting which describes the list element and acceptable entries. The user can utilize this error reporting facility to obtain help in entering list element values by typing "/H" for list elements that require a numeric input. "/H" should not be typed for an element that requires an ASCII string input because the editor will take "/H" as the entry for that element. When the last element of the list has been edited the file will be closed retaining all changes and SSEDIT will then return to the appropriate menu. If the user aborts the edit of a logical record by typing Ctrl C (control C), SSEDIT will return to the RT-11 monitor without updating that record.

3.1.1.1 Edit Attribute List

Selecting to edit the attribute list generates a second menu as follows:

```

ATTRIBUTE MENU
-1 = EXIT
OTHER = ATTRIBUTE NUMBER
?
```

EXIT returns to the main menu. OTHER enables editing of the attribute that corresponds to the entered number.

The display heading for edit of the selected attribute list consists of attribute number and variable name for discrete and analog data types. Since special data and blank records have no associated variable names, the data type will be displayed in place of variable name in the heading.

SSEDIT sequentially edits individual attribute list elements, displaying only information relative to the processing of the particular data type. For example, when analog data is not treated as a level and the variable is in volts (no conversion to engineering units) then the editor does not request entries for conversion tables and engineering unit description.

(3.1.1.1.1 Changing the Data Type)

There are four entries for data type: Blank record, Discrete data, Analog data, or Special data. When the data type is changed to blank record, SSEDIT will ask the user if he is sure about blanking (deleting) that attribute number. The user responds with Y or N for yes or no. When yes, the record is blanked by writing all zeroes, the disk file is updated, and return is made to the edit attribute menu. If the user does not want to delete the attribute number, the editor will re-display the data type and prompt the user again.

Specifying a change from one data type to another (for example, discrete to analog) will cause the editor to first zero all list elements other than data type. Then it will step through the list elements. Since user edits are not made permanent in the disk file until after the last list element has been edited, the user can delete the data type change and revert to the previous information associated with that attribute number by entering Ctrl C (control C) and thus aborting the edit.

(3.1.1.1.2 Justification of ASCII Strings)

Entries that require user input of ASCII string, such as variable names, messages, and engineering unit descriptions are filled with leading blanks by SSEDIT so that the string will be stored right justified in the attribute file.

(3.1.1.1.3 Entering Volts to Engineering Units Conversion Table)

Specifying a conversion from volts to engineering units for analog data type not treated as a level requires a conversion table of "paired points". Each paired point consists of a voltage and corresponding engineering units value. As SSEDIT steps through the paired points in the conversion table, it checks that the voltages are in ascending order. If a voltage is less than or equal to the previous point's voltage, an error message is output and SSEDIT restarts the table with the first paired point.

3.1.1.2 Edit Decommutation List

Edit of the decommutation list is similar to editing the attribute list with the exception being that the decommutation list is a one record file and thus requires no specification of record number. The seven decommutation list elements are stepped through for user edit. After the last list element has been edited, the disk file is updated and SSEDIT returns to its main menu.

3.1.1.3 Edit Display List and Edit Print List

The display list and print list have identical formats and therefore use the same editing techniques. Editing is initiated by selecting an option and item numbers from the edit menu:

DISPLAY LIST EDIT MENU

I, n	=	INSERT AT ITEM n
D, n, nl	=	DELETE ITEMS n THRU nl
C, n	=	CHANGE ITEM n
L, n, nl	=	LIST ITEMS n THRU nl
S, n, nl	=	SAVE ITEMS n THRU nl
U, n	=	UNSAVE AT ITEM n
E	=	EXIT
?	=	

Items correspond to logical record numbers from the open-ended file and are numbered consecutively starting with 0. The second item number (nl) in the Delete, List, and Save commands is optional and when specified must be greater than the first item number. When nl is greater than the number of items contained in the list, the command acts on item n up to the last item in the list.

Execution of insert, Save, Unsave, Change, or Delete commands create a temporary file SSTEMP.DAT on device DK. This file functions as a back-up of the original list and is deleted at completion of the command.

(3.1.1.3.1 Insert)

The insert command allows entry of new items into the list. Frame number of the variable, word number of the variable in frame, and the number of the attribute which describes the variable are entered using this command. After entry of the attribute number, either the variable name or the data type of the attribute is displayed. Additional items can be sequentially inserted into the list before returning to the list's edit menu.

Items are inserted into the list at the specified position number. The item previously associated with this position is shifted downward in the list along with any other items that follow. For example, assume an existing list has two items numbered 0 and 1. Specifying an insert at item 1 will cause the old item 1 to become item 2. The inserted item assumes position 1 and item 0 remains unchanged.

(3.1.1.3.2 Delete)

The Delete command allows for removal of single or multiple items from the list. Protection against accidental deletions is provided by asking the user to confirm his intentions. Any items that follow the deleted item(s) are renumbered and shifted upward in the list.

(3.1.1.3.3 Change)

The change command allows the user to modify the contents of any single item in the display or print list. Item number, associated attribute number, and the attribute's variable name or data type are displayed for the selected item. Procedures for modifying the list elements are identical to attribute and decommutation list edits. Whenever the item's attribute number is changed, the variable name or data type of the new attribute is displayed. Return to the print or display list edit menu is made by entering a carriage return.

(3.1.1.3.4 List)

The List command is provided to allow examination of single or multiple item contents while still in the edit mode. Item number, frame number, word number in frame, attribute number, and variable name or data type are displayed for the specified item(s) in the same format as the main menu's list display option.

(3.1.1.3.5 Save)

The Save command allows list items to be stored in a temporary file (SSSAVE.DAT), and subsequently inserted into one or more places in the list. Issuing the Save command destroys any previously saved items in the temporary file. Items saved are accessible until the display/print list edit mode is exited by returning to the main menu.

(3.1.1.3.6 Unsave)

The unsave command inserts the entire contents of the temporary save file into the list at the specified item. This command can be used to move blocks of items or to insert the same block in several places. The contents of the temporary file are not destroyed and can be unsaved as many times as desired.

(3.1.1.3.7 Exit)

The Exit command terminates editing of the display or print list and returns to the main menu. There are no arguments for this command.

3.1.2 DISPLAYING THE LISTS

The contents of all four lists can be displayed on the VT55 terminal by selection from the main menu.

3.1.2.1 Display Attribute List

Selecting to display the attribute list generates a second menu as follows:

ATTRIBUTE MENU

-1 = EXIT
9999 = ENTIRE LIST
OTHER = ATTRIBUTE NUMBER

?

EXIT returns to the main menu. ENTIRE LIST generates a scrolled display of all the non-blank attributes. The third option (OTHER) displays only the list belonging to the entered attribute number

Attribute list elements are displayed as they occur in the list, using the same format as does edit attribute list with the exception of prompt lines. Entering a carriage return after the last element has been displayed causes a return to the attribute menu.

3.1.2.2 Display Decommutation List

Selecting to display the decommutation list will not generate a second menu since it is a single record file. The seven elements are displayed as they occur in the list. Entering a carriage return after the last element is displayed causes an exit to the main menu.

3.1.2.3 Display Print List and Display List

Selecting to display either the print list or the display list generates a displayed menu similar to the second menu generated for display of the attribute list. Item number, frame number, word number in frame, attribute number, and the attribute's variable name or data type are subsequently displayed one item per row on the VT55 screen. Entering a carriage return after the last displayed item causes a return to the display menu.

3.1.3 PRINTING THE LISTS

The contents of the attribute, decommutation, display, and print lists can be printed on the Line Printer (LA36) through selection from the main menu. Procedures for list printing are identical to those outlined for displaying the lists.

3.2 SSRUN Operation

The Snap Shot system reports all telemetry data on the display screen and printer through program SSRUN using previously defined attribute, decommutation, display and print lists. The data items are reported in the order they appear in the display and print lists. The operator has the option of selecting a display and/or

printout in either a single snap shot or a monitor mode. SSRUN can be executed through the RT-11 monitor "RUN" command. The attribute, decommutation, display, and print list files must all reside on logical device DK.

The menu for SSRUN selections is displayed as follows:

SSRUN MENU

- 1 = SINGLE SNAP SHOT ON DISPLAY LIST
- 2 = SINGLE SNAP SHOT ON PRINT LIST
- 3 = SINGLE SNAP SHOT ON BOTH LISTS
- 4 = MONITOR ON DISPLAY LIST
- 5 = MONITOR ON PRINT LIST
- 6 = MONITOR ON BOTH LISTS
- 1 = EXIT
- ?

This menu appears at the program start-up and at the completion of a single snap shot display or printout.

3.2.1 SINGLE SNAP SHOTS

Selecting a single snap shot enables data reporting from the display list on the VT55 screen (menu selection 1), or from the print list with printout on the LA36 DECwriter (selection 2), or both (selection 3). When the display list is used, the operator is requested to enter a carriage return in order to return to the SSRUN menu after the list has been displayed.

3.2.2 SNAP SHOT MONITOR

The monitor mode provides continuous data reporting. At the completion of a display or printout, the next major frame of PCM data is input and the same list items are reported from the new frame. Monitoring of PCM frames will continue in this manner until a Ctrl C is entered which will terminate SSRUN execution and return to the RT-11 monitor.

Monitoring on the display list will cause the display's cursor to be sent to the home position prior to display of each PCM frame when there are less than 22 items in the display list. This feature allows the user to monitor the data without any line scrolling on the display screen. When there are 22 or more items in the display list, the screen contents will be scrolled upwards when the end of the screen is reached.

3.2.3 DATA REPORTING

3.2.3.1 Display and Printout Formats

Each major frame of PCM data is preceded by a heading consisting of the RT-11 system date and time of day. IRIG time code is also listed when available. The PCM data is reported in a 80 column field as shown in Table 2. Limit check exceedences and errors are reported by an asterisk in column 1.

Table 2. SSRUN Data Reporting Format

Column	Description	Format
1	Limit check & error flag	A1
3-7	Frame number	I5
8-12	Word number	I5
14-43	Variable name	I5A2
45-55	Voltage before conversion to engineering units	1PE10.2, 1HV
71-80	Data units or message	5A2

3.2.4 DATA HANDLING

3.2.4.1 Discrete Data

Discrete data is processed by SSLIB Subroutine SSDISC. The data word is one's complimented when inversion is requested. Data is reported with variable name and a corresponding message for data values of 0 or 1. An asterisk will appear in column 1 when data equals a pre-defined "bad" state or if the discrete data value was not 0 or 1.

3.2.4.2 Analog Data

Processing of all analog data is controlled by Subroutine SSANLG. The analog data is inverted by one's complimenting (optional), then masked, normalized and signed according to A/D type.

3.2.4.3 Two's Complement A/D Data

When the data has been digitized by a two's complement A/D, the most significant bit of the data mask is used as the sign bit position. The data word is sign extended to 16 bits according to the state of the data bit that corresponds to the mask's sign bit.

3.2.4.4 Offset Binary A/D Data

Data from an offset binary A/D is unsigned and assumed to be less than 16 bits wide.

3.2.4.5 Sign Magnitude A/D Data

The most significant bit of the data word mask is the sign bit position for sign magnitude A/D data. The data word is assumed to be negative when the data word bit corresponding to the mask sign bit is a 1. When negative, the sign bit is cleared and the data word is two's complimented.

3.2.4.6 Conversion From A/D Counts to Volts

Data is converted from A/D counts to volts by the following equation:

$$\text{Volts} = (\text{Data} * \text{SF} + \text{Bias}) * \text{Gain}$$

where:

Data = data word in A/D counts
SF = scale factor in volts per count
Bias = volts at 0 A/D counts
Gain = optional gain from 1 of 4 states

3.2.4.7 Analog Data Not Treated as a Level

Subroutine SSNLEV processes analog data not treated as a level.

3.2.4.8 Conversion to Engineering Units

Volts are optionally converted to engineering units using a conversion table consisting of up to ten [V(n), X(n)] paired points and a first-order (MX+B) conversion. Whenever a voltage falls outside the range of the table, conversion is done by extending M based on the table's extreme points. Data converted to engineering units are reported with both voltage and engineering units along with engineering unit description.

3.2.4.9 Processing Analog Data Treated as a Level

Subroutine SSALEV processes analog data treated as a level. Limit checks on voltages below or above (greater than or equal to) decision point voltages are performed as directed by the attribute list. Data reports consist of limit check flag, frame number, word number of the variable in frame, variable name, voltage, and messages if below or above the decision point voltage.

3.2.4.10 Special Data

Special data is defined as a variable that does not fit into a discrete or analog data type. Analog data packed into two PCM words would be an example of special data. To process special data the user must apply two subroutines: SSSPEC and a specific conversion routine.

4. CONCLUSION

In its present configuration the system works and works well. When operating in the "Monitor" mode the display on the video terminal is updated about once every four seconds. This gives an easy flow to the engineering data units into the mind and trends can be readily spotted even without flags showing out of limit data.

We have used the programs to assist in data analysis on post-flight tapes from both the MSMP TEM-2 flight and the BMP ZIP flight. However, there are some recognizable problems which can be eliminated to improve performance. For the most part these problems fall into the nature of hardware restrictions.

The major problem is created because the system requires that the DEC Writer (LA 36) pretend that it is a line printer. This drastically slows down the throughput because everything must wait until the printer finishes before the next "Snap Shot" of data is taken.

Secondarily, there is a hardware driven software problem. Since the system has only one video terminal there is a limited amount of data that can be displayed at any one time. Presently only 22 lines of data can be displayed on the terminal. This is a bare 3% of the available data on MSMP.

This can be altered by adding more video terminals, but the software needs to be changed to reflect this added capability of the system. Each terminal would add 3% more display capability.

Appendix A

List Specifications and Contents

A1. GLOSSARY OF TERMS USED

This section details SSEDIT entries and the contents of the attribute, decommutation, display, and print lists. The following keywords are used in outlining these lists:

<u>TYPE</u>	refers to the word's data type:
I	Integer number
R	Real number
O	Octal number
A	ASCII string
<u>VALUE</u>	refers to the word's data value:
#	user defined numerical value
A	ASCII string (right justified)
0, 1, 2	SSEDIT assigned values usually representing processing options
<u>INPUT</u>	refers to the user's SSEDIT entries:
*	ASCII string (in 10A or 30A format)
A-Z	one character entries usually representing processing options
#	a number conforming to data type, formatted as follows:
<u>data type</u>	<u>input format</u>
R	F13.5
I	I6
O	O6

A2. ATTRIBUTE LIST SSLA.DAT

File type: random access
 Logical record length: 100 words
 Logical records per file: 200
 RT-11 blocks per file 79

A2.1 Contents for One Attribute

<u>WORD</u>	<u>SSLA. DAT TYPE</u>	<u>VALUE</u>	<u>SSEdit INPUT</u>	<u>MEANING</u>
Ø	I	Ø	B	blank record
		1	D	discrete data
		2	A	analog data
		3	S	special data
1	O	#	#	mask to select variable

A2.1.1 DISCRETE DATA

<u>WORD</u>	<u>SSLA. DAT TYPE</u>	<u>VALUE</u>	<u>SSEdit INPUT</u>	<u>MEANING</u>
2	I	Ø	N	do not invert
		1	Y	invert (1's compliment)
3	I	Ø	N	do not limit check
		1	Y	limit check
4	I	Ø	Ø	variable bad if = Ø
		1	1	variable bad if = 1
5-19	A	A	*	variable name (up to 3Ø chars.)
20-24	A	A	*	message if discrete = Ø (up to 1Ø characters)
25-29	A	A	*	message if discrete = 1 (up to 1Ø characters)
30-99				spare

A2.1.2 ANALOG DATA

WORD	SSLA. DAT TYPE	VALUE	SSEDIT INPUT	MEANING
2	I	0	N	do not invert
		1	Y	invert (1's compliment)
3	I	0	T	two's compliment a/d data
		1	O	offset binary a/d data
		2	S	sign magnitude a/d data
4-5	R	#	#	volts at 0 a/d counts
6-7	R	#	#	volts per a/d count
8	I	0	N	no qualifying gain
		1	Y	qualifying gain
9	O	#	#	mask for qualifying gain
10	I	0	N	do not invert gain state
		1	Y	invert gain state (1's compliment)
11-12	R	#	#	gain associated with state 0
13-14	R	#	#	gain associated with state 1
15-16	R	#	#	gain associated with state 2
17-18	R	#	#	gain associated with state 3
19	I	0	N	do not treat variable as a level
		1	Y	treat variable as a level

A2.1.2.1 Analog Data Not Treated as a Level

WORD	SSLA. DAT TYPE	VALUE	SSEDIT INPUT	MEANING
20	I	0	N	do not convert
		1	Y	convert to engineering units
21	I	#	#	number of paired points in conversion table (2 ≤ # ≤ 10)
22-23	R	#	#	voltage of first point in table
24-25	R	#	#	engineering units of first point
26-61	R	#	#	remainder of table (v(n) < v(n+1))
62	I	0	N	do not limit check
		1	Y	limit check
63-64	R	#	#	value of low limit
65-66	R	#	#	value of high limit
67-81	A	A	*	variable name (30 chars max)
82-86	A	A	*	engineering units description (10 characters maximum)
87-99				spare

A2.1.2.2 Analog Data Treated as a Level

<u>WORD</u>	<u>SSLA. DAT TYPE</u>	<u>VALUE</u>	<u>SSEDIT INPUT</u>	<u>MEANING</u>
20	I	0 1	N Y	do not limit check limit check
21-22	R	#	#	voltage of decision point
23	I	0 1	L H	error if below decision voltage error if above decision voltage
24-38	A	A	*	variable name (30 chars max)
39-43	A	A	*	message if below decision voltage (10 chars max)
44-48	A	A	*	message if above decision voltage (10 chars max)
49-99				spare

A2.1.3 SPECIAL DATA

<u>WORD</u>	<u>SSLA. DAT TYPE</u>	<u>VALUE</u>	<u>SSEDIT INPUT</u>	<u>MEANING</u>
2	I	#	#	value (Fortran Index) for computed go to in SSSPEC
3-99				spare

A3. DECOMUTATION LIST SSLB.DAT

File type: sequential
 Logical record length: 250 words
 Logical records per file: 1
 RT-11 blocks per file: 1

A3.1 Contents

<u>WORD</u>	<u>SSLB. DAT TYPE</u>	<u>VALUE</u>	<u>SSEDIT INPUT</u>	<u>MEANING</u>
0	O	#	#	sync pattern right justified (most significant 16 bits)
1	O	#	#	mask for sync pattern
2	I	#	#	word length (bits)
3	I	#	#	number of words in minor frame
4	I	#	#	word number of frame counter (Note: 1 implies major frame = minor frame)
5	I	#	#	word number of frame counter (sync pattern of word 0)
6	O	#	#	mask for frame counter
7-249				spare
EOF				

A4. DISPLAY LIST SSLC.DAT

File type: sequential
Logical record length: 3 words
Logical records per file: 1
RT-11 blocks per file: 1 per 85 items

A4.1 Contents

<u>WORD</u>	<u>SSLC.DAT</u> <u>TYPE</u>	<u>VALUE</u>	<u>SSEDIT</u> <u>INPUT</u>	<u>MEANING</u>
0	I	#	#	frame number of variable
1	I	#	#	word number of variable in frame
2	I	#	#	attribute number
.				
.				
.				
EOF				

A5. PRINT LIST SSLD.DAT

File type: sequential
Logical record length: 3 words
Logical records per file: 1
RT-11 blocks per file: 1 per 85 items

A5.1 Contents

<u>WORD</u>	<u>SSLD.DAT</u> <u>TYPE</u>	<u>VALUE</u>	<u>SSEDIT</u> <u>INPUT</u>	<u>MEANING</u>
0	I	#	#	frame number of variable
1	I	#	#	word number of variable in frame
2	I	#	#	attribute number
.				
.				
.				additional logical records
EOF				

Appendix B

SSLIB Subroutine Library

The library entitled SSLIB consists of 22 subroutines written in Fortran and MACRO-11. These routines are used by the SSEDIT and SSRUN programs.

B1. SUBROUTINE ERASE(LINE)

Erases screen and positions cursor in column 1 of line number passed as subroutine argument.

B2. SUBROUTINE FILL(N,STRING)

Fills a string with "N" leading blanks.

B3. SUBROUTINE GETIME(RTDATE,RTTIME,IRGTIM,IRG)

Subroutine returns the following time information:

RTDATE = 9 character ASCII RT-11 current date
RTTIME = 8 character ASCII RT-11 current time
IRGTIM = 15 character IRG Julian day and time

When IRG date and time is not available, the logical variable IRG will be returned false.

B4. SUBROUTINE GETIRG (IRGTIM,IRG)

Returns 15 character ASCII IRG Julian date and time. When IRG time is not available, the logical variable IRG is returned false.

B5. SUBROUTINE GETNAM (NAME)

Returns 30 character variable name from discrete or analog attribute lists. Character string is returned right justified.

B6. SUBROUTINE GETSTR (N,STRING)

Reads an N character ASCII string from keyboard and returns it right justified. N must be less than or equal to 30.

B7. SUBROUTINE GETYN (IFLAG)

Subroutine accepts ASCII yes or no input from keyboard and returns a corresponding value in IFLAG: 0 = no, 1 = yes. IFLAG is returned unchanged if sole input was a <cr>. Only the first character of response is examined. If it is not one of the three acceptable inputs or if help is requested then a brief message is output and the user is prompted.

B8. SUBROUTINE HOME

Moves display cursor to home position.

B9. SUBROUTINE LAMENU (EDIT,NATT)

Displays attribute list sub menu, accepts user response and returns response in NATT. When display or print command (EDIT = .false.) a response equal to LADUMP will be accepted to enable display/print of entire file.

B10. SUBROUTINE LAOPEN (INIT,LAUNIT)

Opens direct access attribute file (SSLA.DAT). Enter with INIT=.true. for SSEDIT initialization. If file does not exist at edit initialization, then a file will be created with every record containing all zeroes.

B11. SUBROUTINE LCLIST

(LISTU, LUNIT, ITEM1, ITEM2, LAUNIT, DPNAME)

Subroutine lists requested items from display or print file on TT or LP.

Enter with:

LISTU = TT = 7 to display items
= LP = 6 to print items
LUNIT = logical unit number of file
ITEM1 = first item (record to list)
ITEM2 = last item to list
LAUNIT = logical unit number of attribute file
DPNAME = ASCII 'DISPLAY' or 'PRINT'

B12. SUBROUTINE LOPEN (INIT,LUNIT)

Opens sequential access files for LUNIT = 2,3,4. Enter with

INIT=.true. for SSEDIT initialization.

File definitions:

LUNIT = 2 decommutation file (SSLB.DAT)
3 display file (SSLC.DAT)
4 print file (SSLD.DAT)

If decommutation file does not exist at edit initialization a one-record file will be created containing all zeroes.

B13. SUBROUTINE SSALEV (VOLTS)

Processes analog data treated as a level. Limit checks on voltages below or above decision voltages are performed as directed by attribute list. Limit check flag, frame number of variable, word number of variable in frame, variable name, voltage, and messages if below or above decision voltage are output by this routine.

Enter subroutine with:

variable attribute list in common /lainfo/
display/print list in common /lcinfo/
output device logical unit number in common /outdev/

B14. SUBROUTINE SSANLG

Processes analog data digitized on two's complement, offset binary, or sign magnitude A/D types. Data is converted from counts to volts, a bias corresponding to volts at 0 A/D counts is added to the data, and gain is then applied. The resulting voltage is passed on to one of two subroutines according to treatment of data as level or not level. When a qualifying gain state is not in the range 0-3, an error message is output containing the gain state and return is made without processing according to level treatment.

Enter this subroutine with:

unmasked variable in common /variab/
variable attribute list in common /lainfo/
display/print list in common /lcinfo/
output device logical unit number in common /outdev/

B15. SUBROUTINE SSDECM

Reads in PCM major frame, finds sync pattern, and sorts data into common block decom such the first word is frame 0, word 0.

Calling arguments:

COMMON /DECOM/ IFRAME(4000) ! Where the data goes.
COMMON /LBINFO/ LBWRDS, LB(250) ! Decommuation list.

LBWRDS = = number of words in decom list LB
LB(1) = LBSYNC = binary right-justified sync pattern
LB(2) = LBSMSK = mask for isolating sync pattern from data word
LB(3) = LBWLEN = word length in bits
LB(4) = LBNWMF = number of words in minor frame
LB(5) = LBNFPF = number of minor frame per major frame
LB(6) = LBCOFF = word number of minor frame counter
LB(7) = LBCMSK = mask for isolating frame count from data word

Hardware of interest:

<u>address</u>	<u>function</u>
172410	DMA word count register
172412	Buffer A starting address
172414	DMA controller control/status register

B16. SUBROUTINE SSDISC

Subroutine processes discrete data type. Compliments, masks, performs limit check and outputs frame number of variable, word number of variable in frame, variable name and message corresponding to discrete state. An asterisk will be output in column 1 if data fails limit check. When the discrete data somehow is not equal to zero or one, then an asterisk is output in column 1 along with the data value and the message "NOT 0 OR 1".

Enter subroutine with:

unmasked variable in common /variab/
variable attribute list in common /lainfo/
display/print list in common /lcinfo/
output device logical unit number in common /outdev/

B17. SUBROUTINE SSGETV (GERROR)

Returns variable defined in display or print list item. The variable is returned unmasked in common block /variab/. Logical #1 GERROR is returned true when frame number or word number defined in display/print list is greater than the frame or word number definition in decommutation list. Enter with decommutation list and display/print list in appropriate common blocks.

B18. SUBROUTINE SSIMN.MAC

SSRUN invert, mask, and normalization subroutine. Subroutine inverts data (1's compliment), masks the data, and returns both the data and mask normalized. The data and mask are normalized by shifting both the data and mask right one place until bit 0 of the mask is a 1.

Fortran call statement:

CALL SSIMN (INVERT, MASK, IDATA)

invert = 0 do not invert before mask

 = 1 invert before mask

mask = mask to apply

idata = integer word to mask

B19. SUBROUTINE SSNLEV (VOLTS)

Processes analog data not treated as a level. Conversion from volts to engineering units and limit checks are performed as directed by attribute list. output consists of limit check failure flag, frame number, word number of variable in frame, and variable name. Volts, engineering units, and a description of engineering units are also output when a voltage conversion takes place. Volts and the description "VOLTS" are output when no conversion has been performed.

Enter subroutine with:

variable attribute list in common /lainfo/
display/print list in common /lcinfo/
output device logical unit number in common /outdev/

B20. SUBROUTINE SSSIGN.MAC

SSRUN sign extension subroutine. Subroutine signs analog data digitized by a two's compliment or sign magnitude A/D. The most significant bit of the mask is used as the sign bit for both A/D data types. Two's compliment A/D data is sign extended to 16 bits according to the MSB of the mask. Sign magnitude A/D data is assumed negative when the data bit corresponding to the MSB of the mask is a 1. In this case, the MSB of the data word is cleared and the data is then two's complimented.

Fortran call statement:

CALL SSSIGN (ADTYPE, MAS, IDATA)

ADTYPE = integer word specifying a/d type

= 0 for two's compliment a/d

<> 0 for sign magnitude a/d

MASK = normalized mask output from SSIMN

IDATA = normalized data as input from SSIMN

B21. SUBROUTINE SSSPEC (N)

This is a user supplied subroutine. For a demo, frame number, word number of variable in frame, "N", and unmasked variable will be output.

B22. SUBROUTINE TRAIL (N,STRIN,STROUT)

Changes leading blanks to trailing blanks in an N character string.